

## How Rings assign address space

Step1: align incoming address to self (to some power of 2)

Step2: assign the result to self address

Step3:  $\text{next\_addr} = \text{self\_addr} + \text{self\_addr\_space}$ ; // number of register used locally

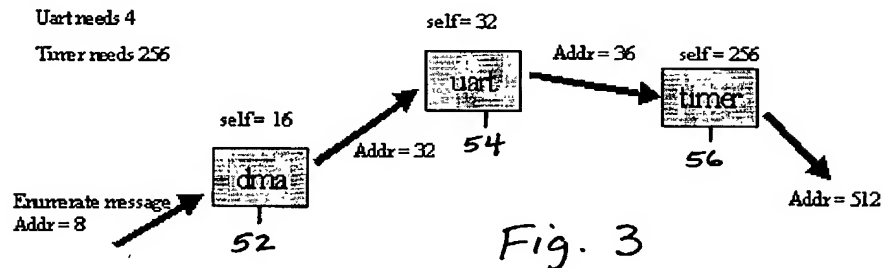
Step4: send down next\_addr

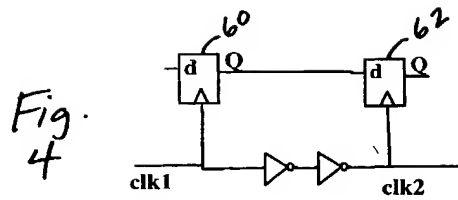
Example:

Dma needs 16 addr

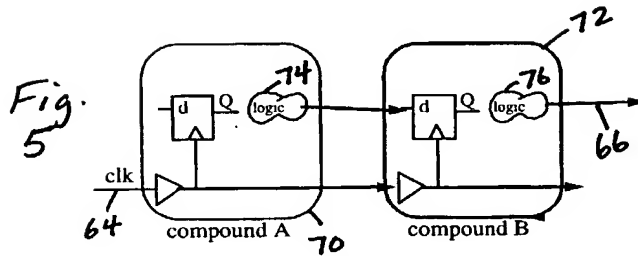
Uart needs 4

Timer needs 256



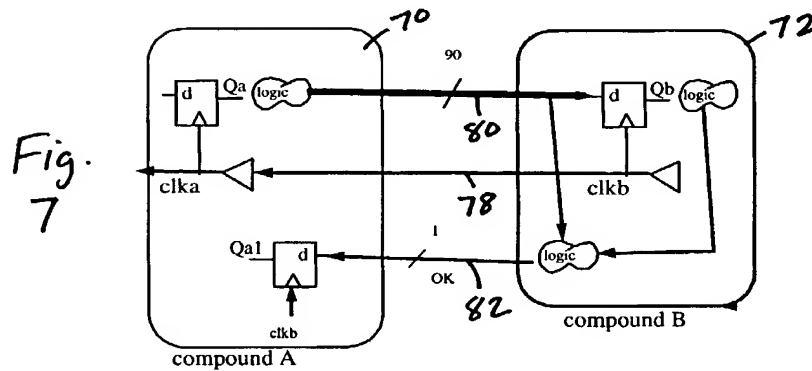
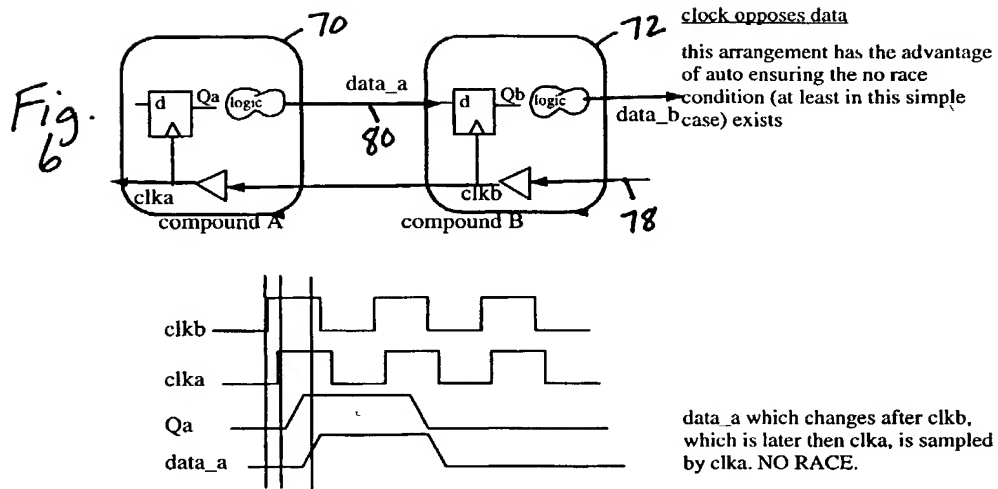


If the delay between "clk1" and "clk2" greater then the delay from Q to d of second flipflop, we have a race on our meaning right hand flipflop will sample the data of Q a whole clock period early.



clock runs with data

the problem is possible race. However, we control the logic on each flipflop leaving the compound, because it is always the same standart ring-interface module. we can ensure, that the delay will be at least enough. And more importantly easily checked after layout.



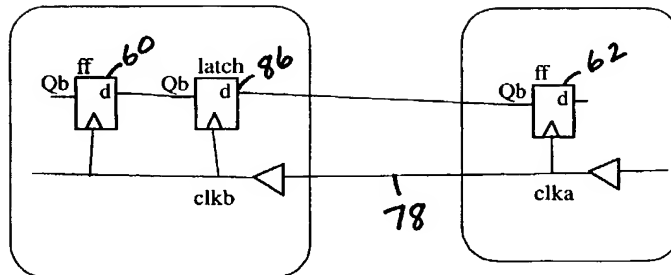


Fig. 8

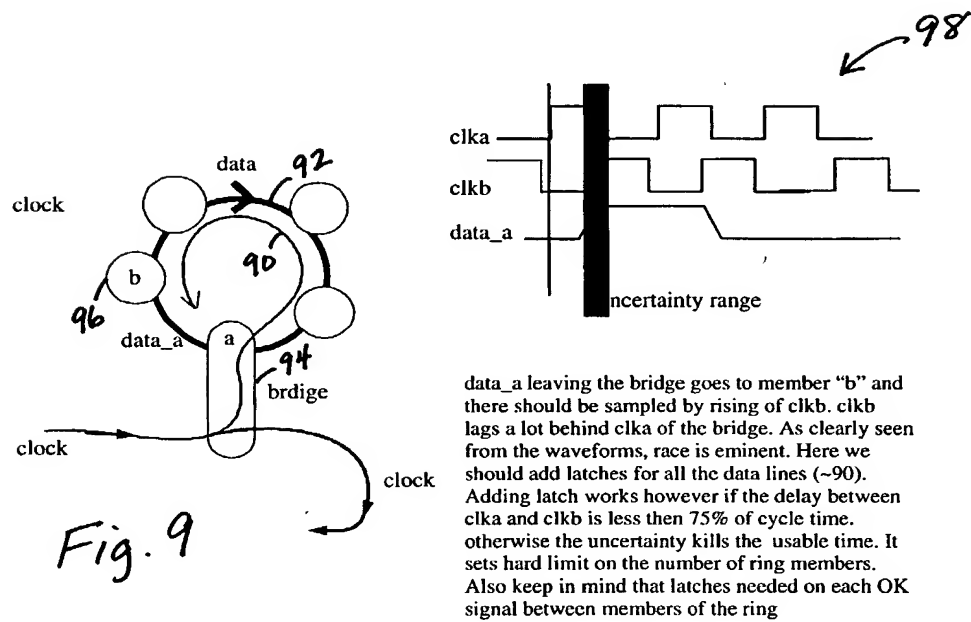


Fig. 9

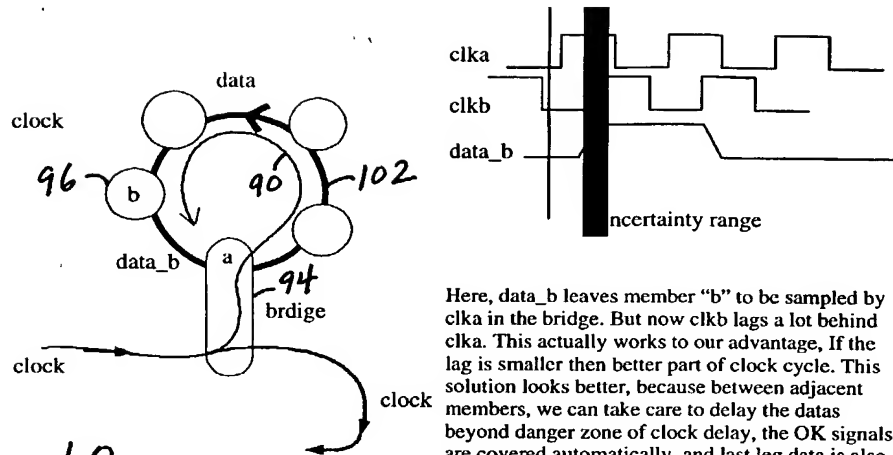


Fig. 11

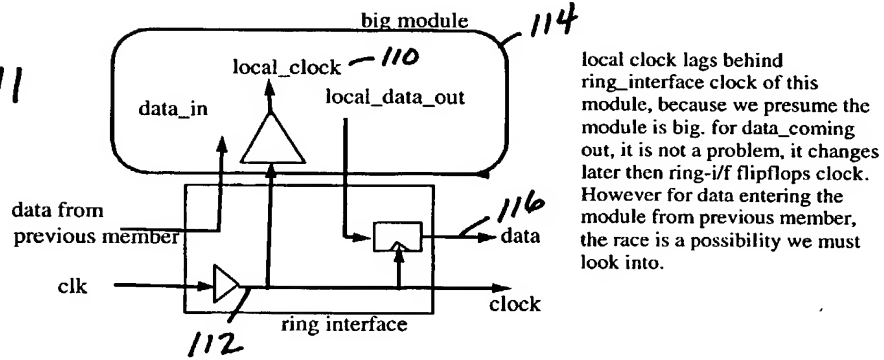
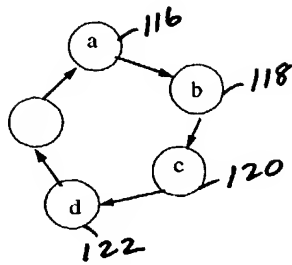


Fig. 12



if module "a" sends a message to module "b", ring works fine. However if most of the traffic is from "c" to "b", this is more expensive in terms of latency.

Another problem is "peak latency". Suppose that, "a" transmits mostly to "d" and "b" mostly to "c". In this case communication between "b" and "c" suffers degradation in case that peak traffic coincide.

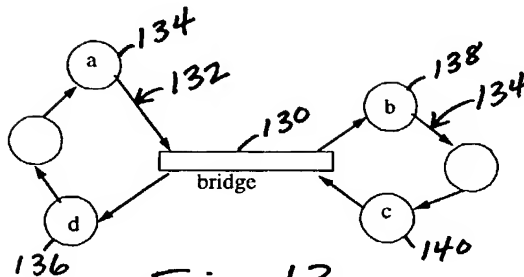
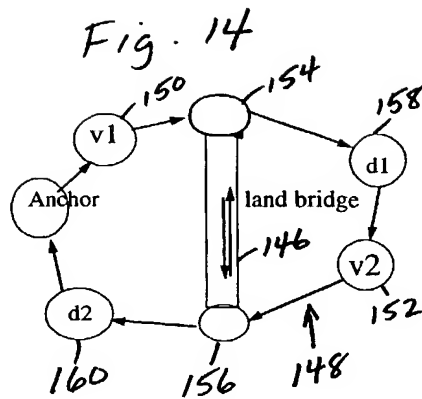
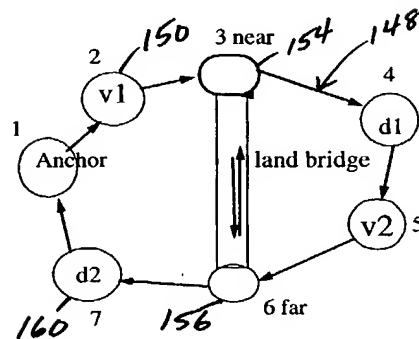


Fig. 13



Land bridge gets its name from the fact that it is a luxury. It spans across connected modules. The idea is simple. When V2 sends message to D1 it gets to one side of the bridge. This side analyzes the destination address and by some magic (explained later) decides to short-cut the path. The message re-appears at the other end of the bridge and gets fast to D1. By same magic, message from V1 to D2 get bypassed also. message from V1 to D1 is treated directly.

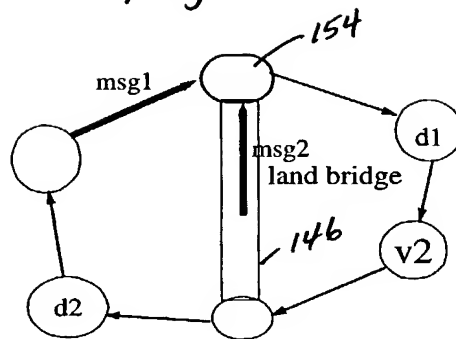


Enumeration is started by "Anchor" which assigns address=1 to itself. results of enumeration are labels 1 to 7. land bridge gets two addresses, as if it were not one module. there is "near" end, that got enumeration label "3", and the "far" end marked 6.

Fig. 15



Fig. 16



msg1 and msg2 arrive at the same time.  
the bridge end must make a decision  
which message to forward first.

It can be shown that unwise decision can  
lead to freezout, deadlock and option price  
dropping to 5\$.

Therefore MSG2 gets the priority.

Fig.  
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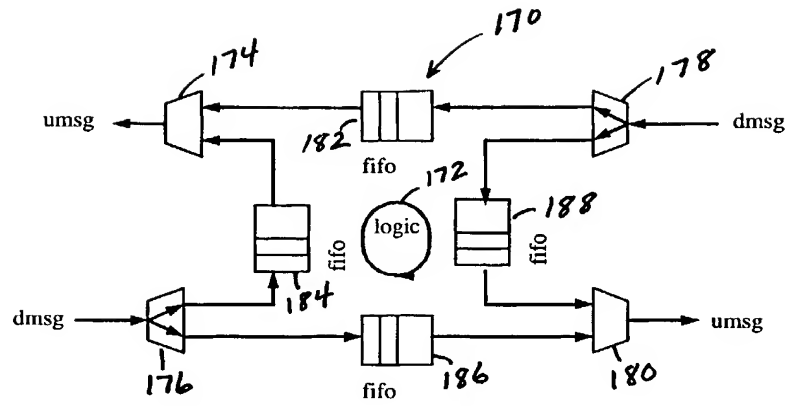
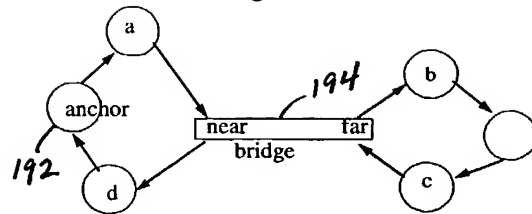


Fig. 18



Bridge takes responsibility for strays, but only at the "far" end. During enumeration, bridge is "polarized" to have near and far end. Near is the end first struck by enumeration message.

So we have exactly one enforcer for each ring.

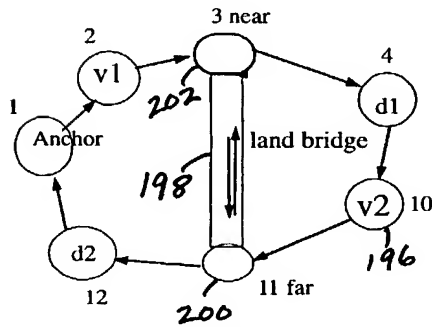


Fig. 19

In land bridge ring, the situation is trickier. If V2 send message to address==5. The land bridge divert at 11/far end. it will re-appear at 3 and start cycling forever.

We have to define an algorithm that will take care of all cases.

Luckily there is a way.

Land Bridge deals only with messages arriving at the far end and being diverted. It marks and monitors only those. Messages arriving at near end, keep their markings. Messages at fdar end going through, are left alone.

Fig. 20

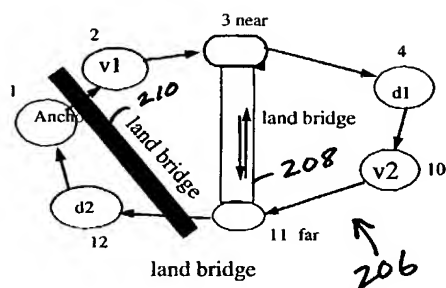


Fig. 21

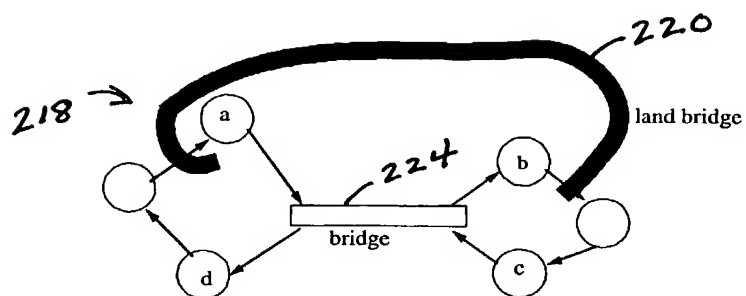
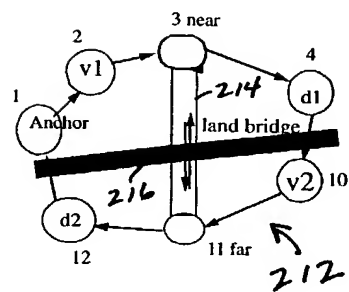
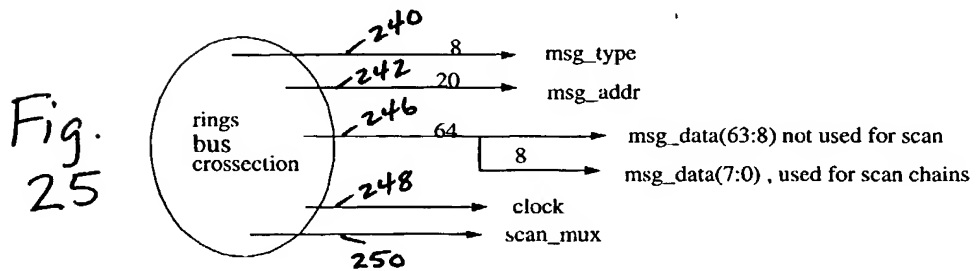
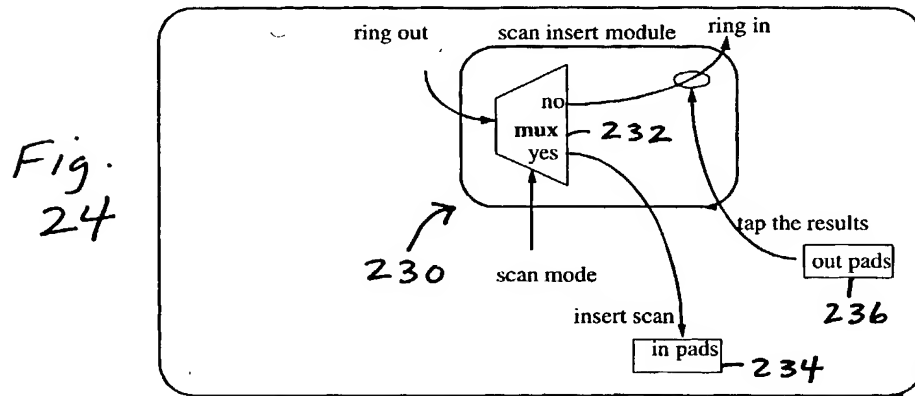
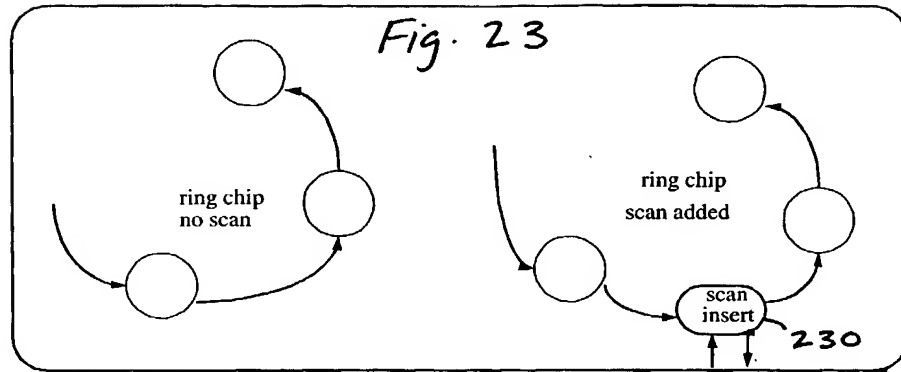
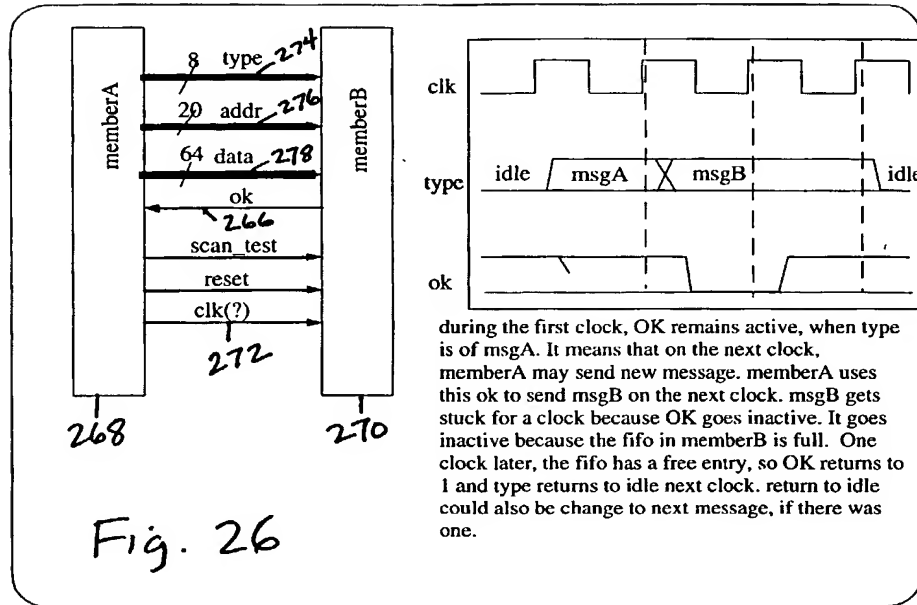


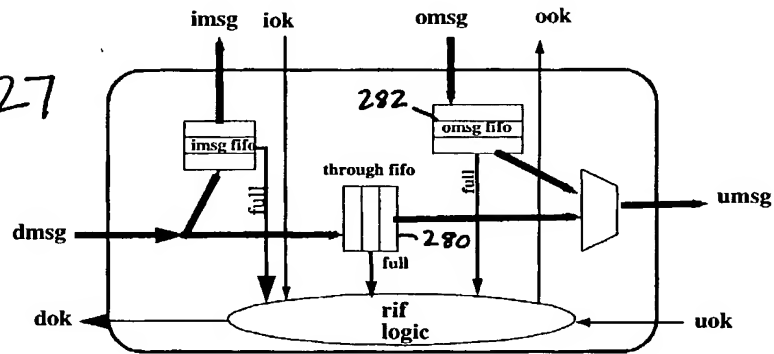
Fig. 22





during the first clock, OK remains active, when type is of msgA. It means that on the next clock, memberA may send new message. memberA uses this ok to send msgB on the next clock. msgB gets stuck for a clock because OK goes inactive. It goes inactive because the fifo in memberB is full. One clock later, the fifo has a free entry, so OK returns to 1 and type returns to idle next clock. return to idle could also be change to next message, if there was one.

Fig. 27





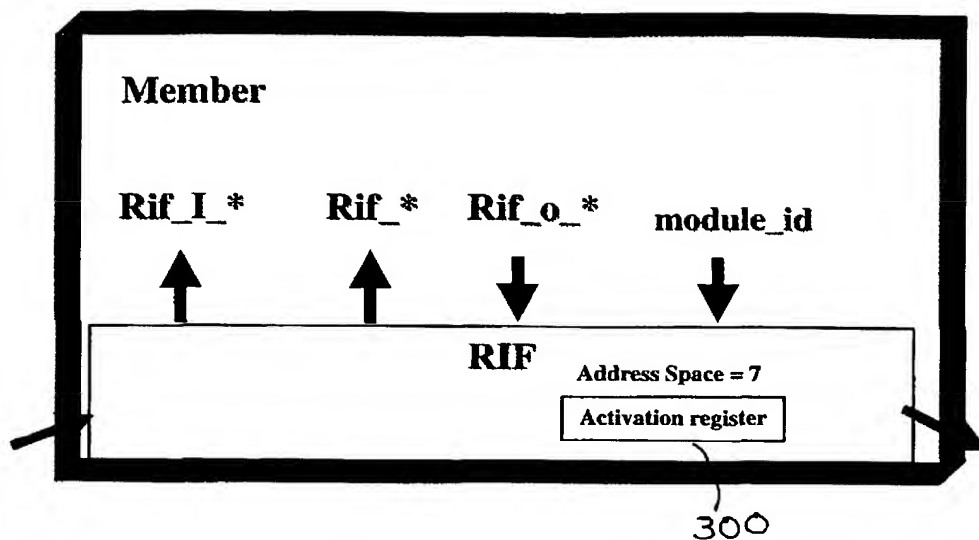
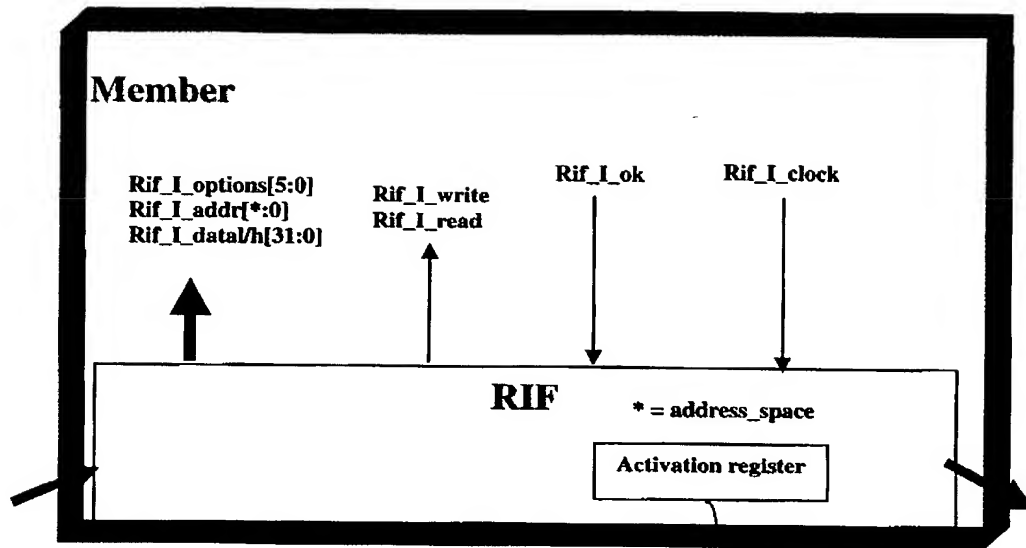


Fig. 30





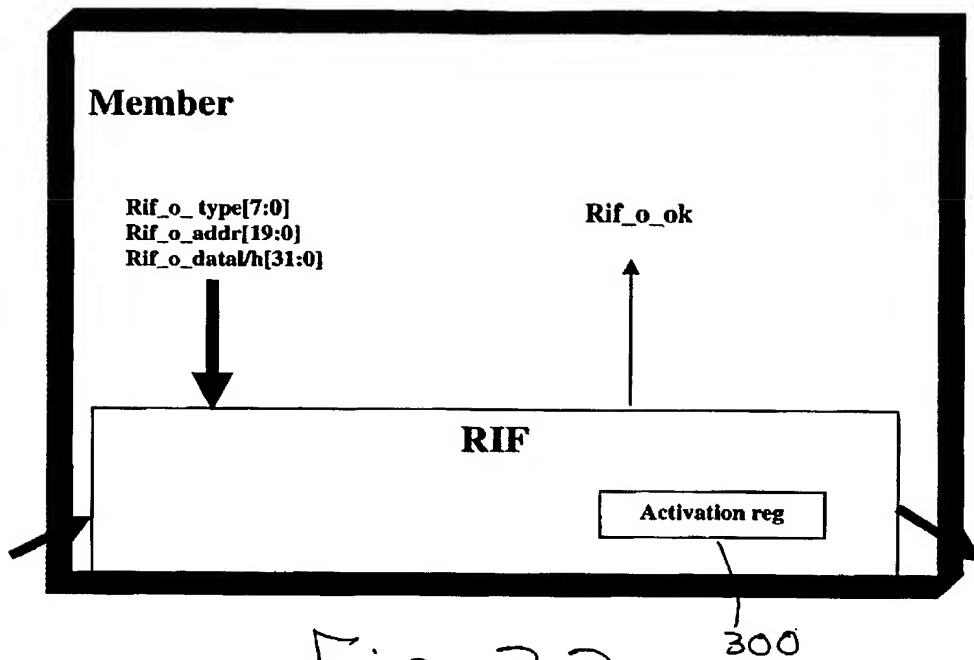


Fig. 32

300

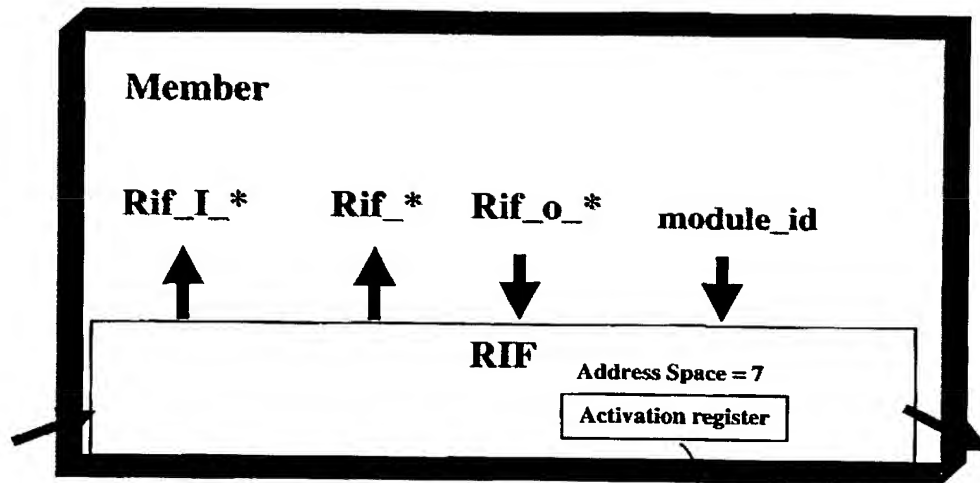
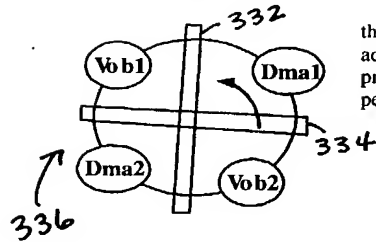


Fig. 33

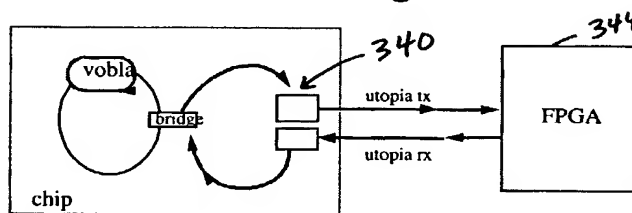
300

Fig. 34



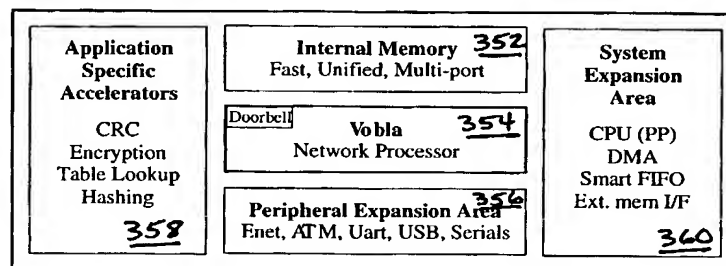
the second land bridge solves most traffic problems, but adds 4 clocks in the overall ring length. This is not a big problem because no message should travel the whole perimeter.

Fig. 35



The utopia interface is forced into mode that communicates in messages, not cells. We using the I/O and maybe some of the logic.

Fig.  
36



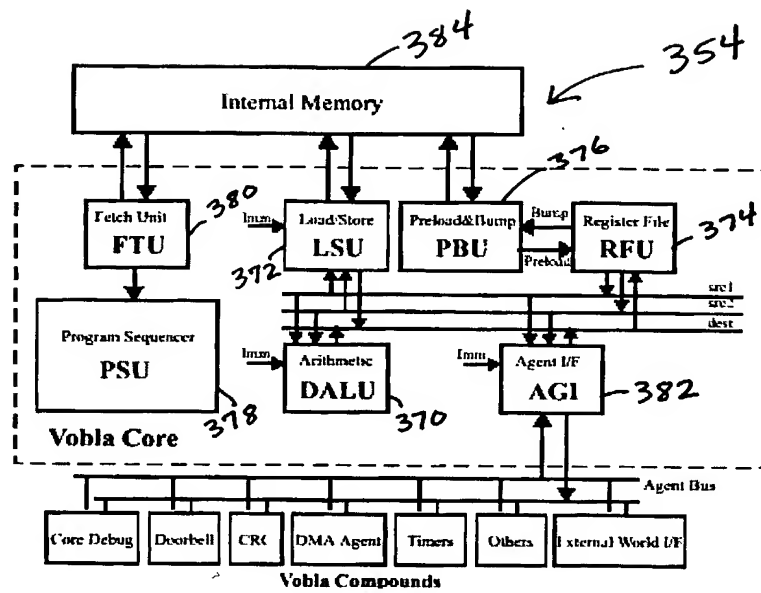
Doorbell      Vo bla      354  
Network Processor

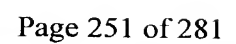
**Peripheral Expansion Area**  
Enet, ATM, Uart, USB, Serials

### System Expansion Area

CPU (PP)  
DMA  
Smart FIFO  
Ext. mem I/F

350





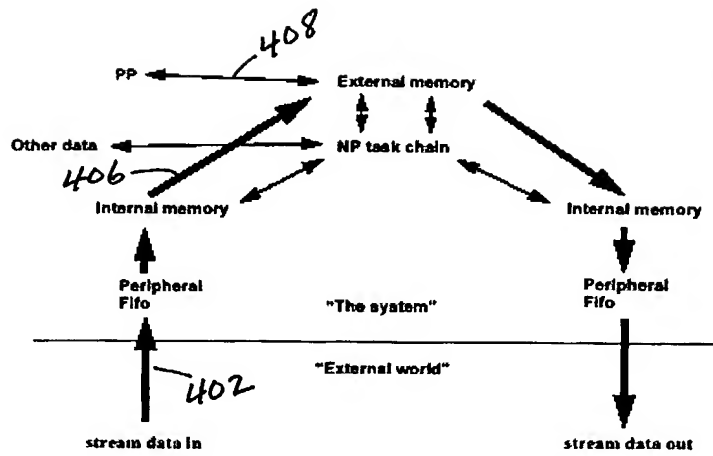


Fig. 39

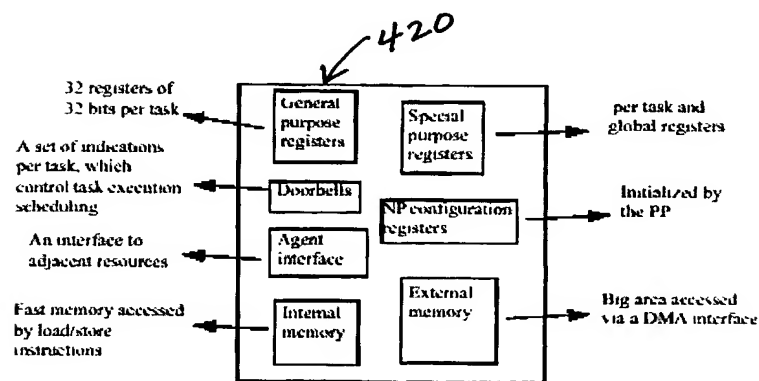


Fig. 40

Fig. 41'

**R1 registers:**



**s** - sticky bit  
**eq** - equal/zero  
**lt** - less than/negative  
**gt** - greater than/positive  
**c** - carry  
**mb** - reflection of the RAM multi-reader busy indication.

430

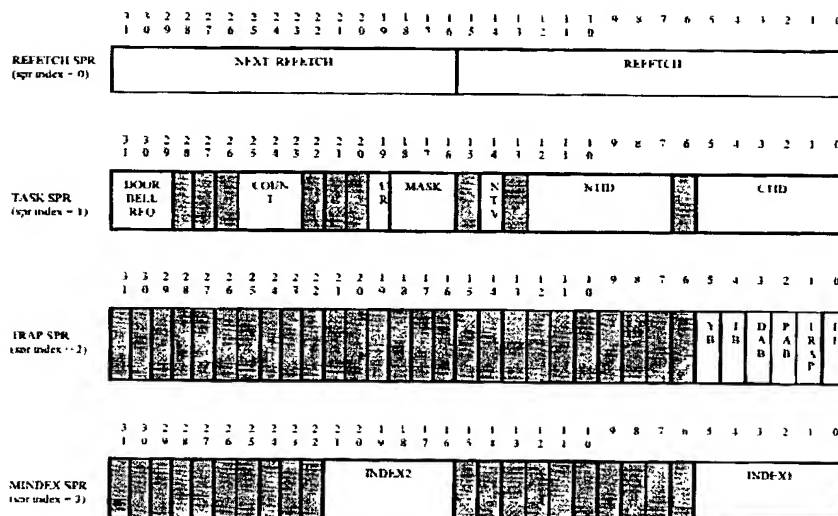


Fig. 42

← 442

✓ 444

446





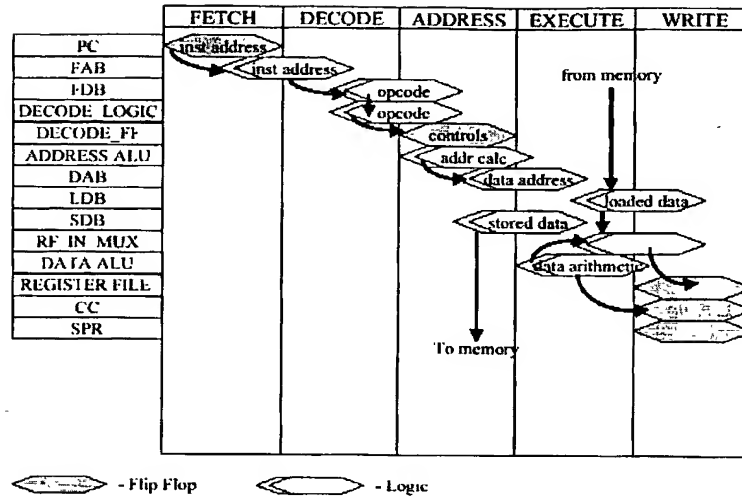


Fig. 46

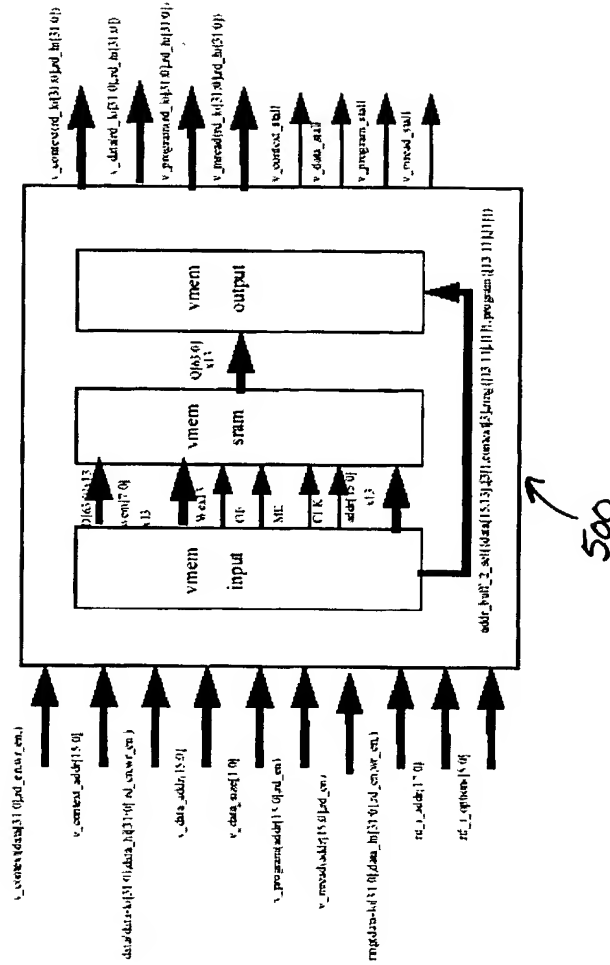
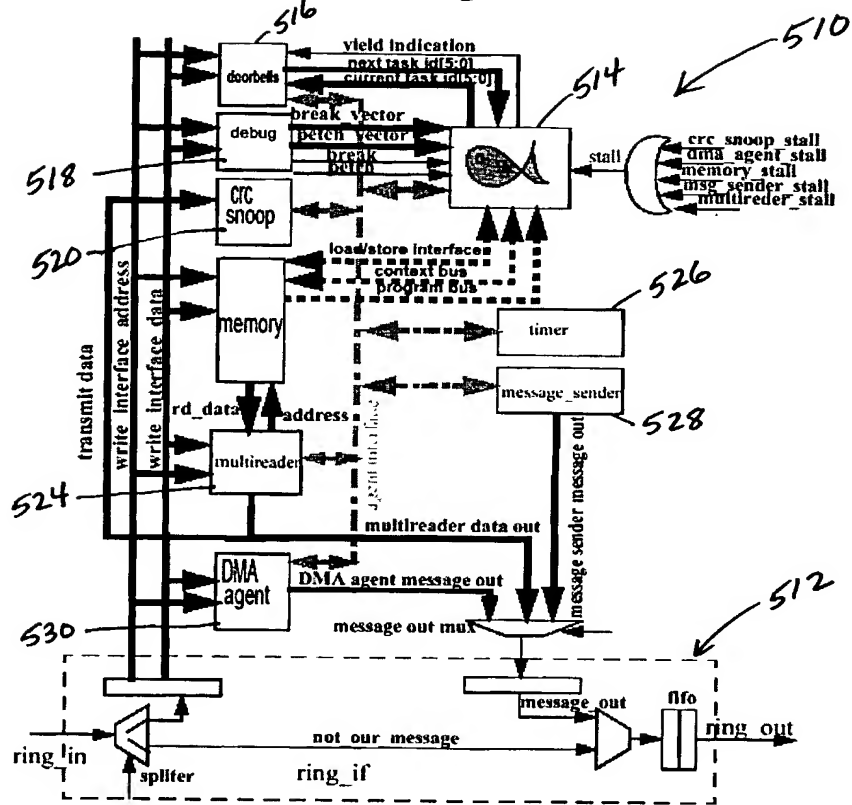


Fig. 47



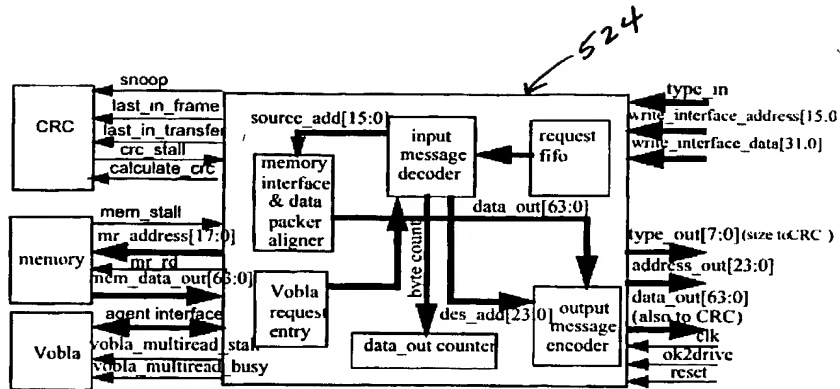


Fig.  
48

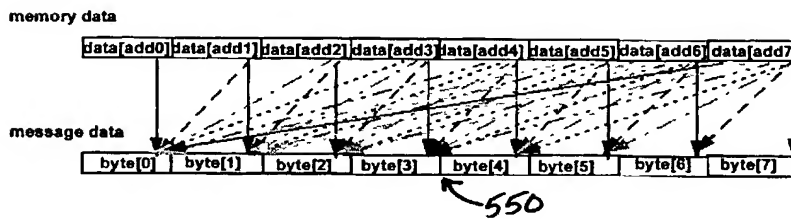


Fig.  
49

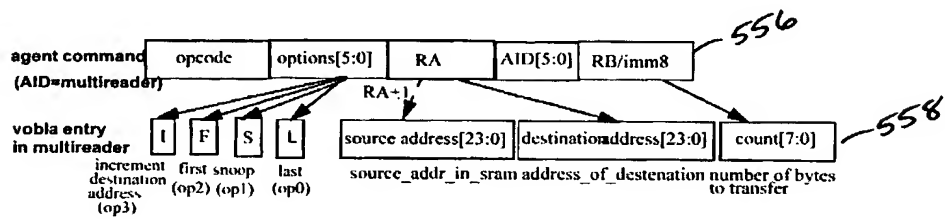
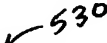
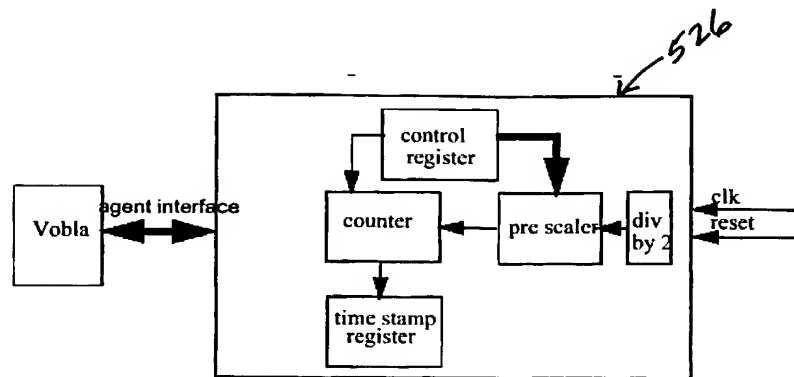
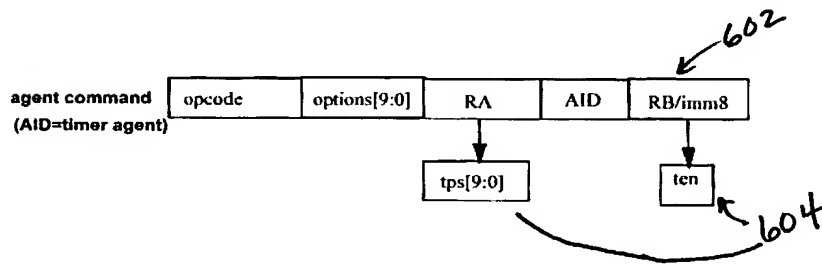


Fig. 50





Fig.  
57Fig.  
58



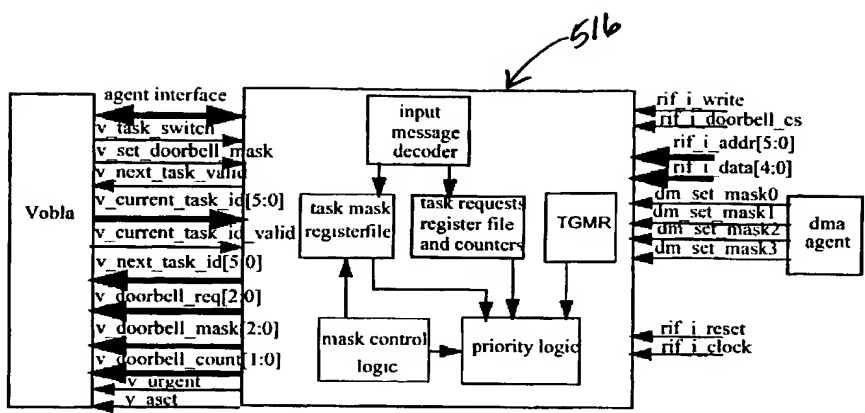


Fig. 59

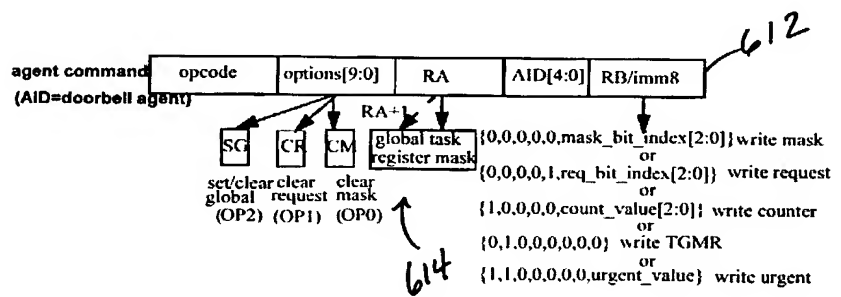
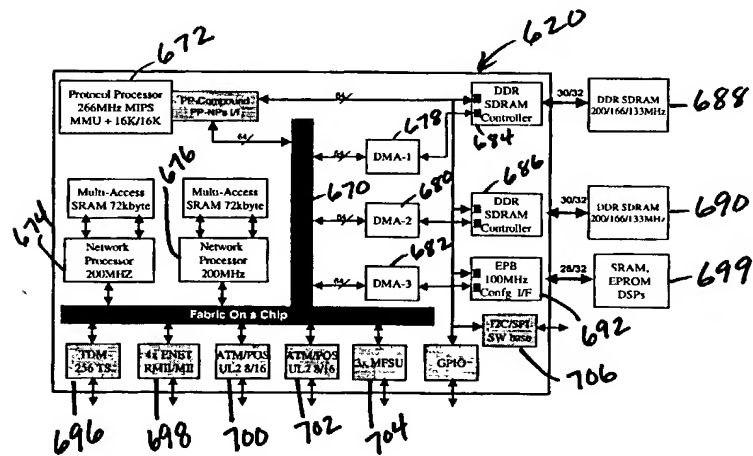
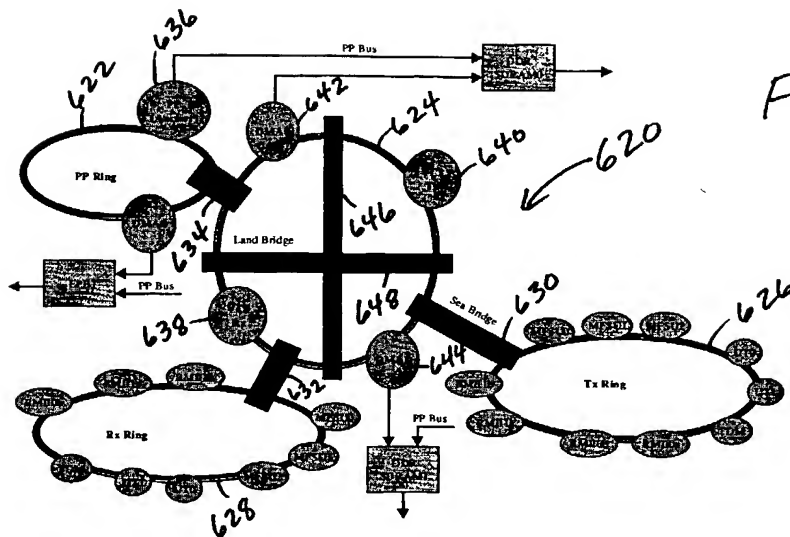
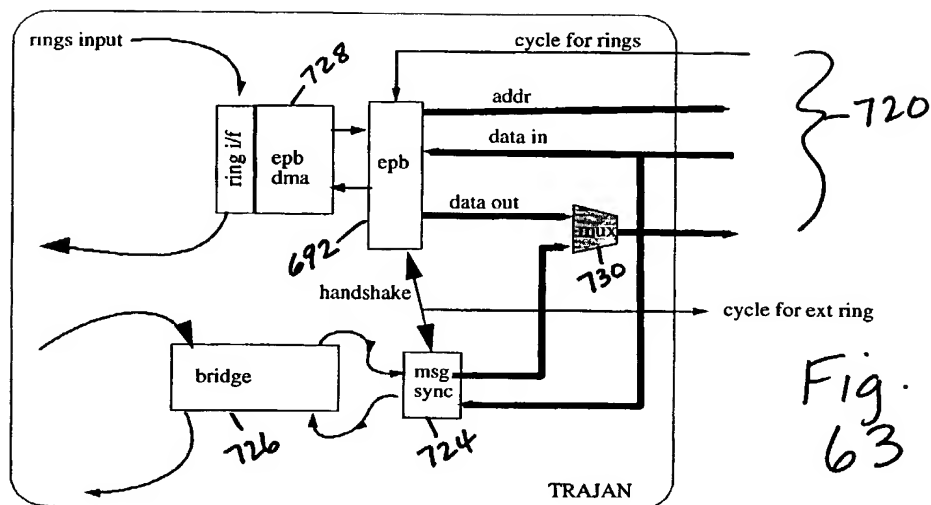


Fig. 60





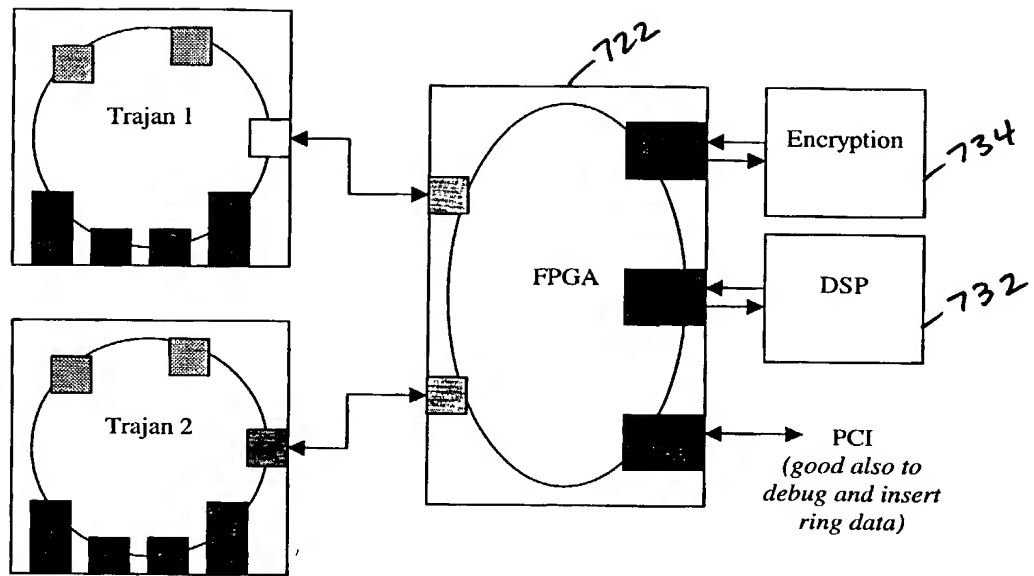


Fig. 64




-  Processor
-  Functional unit
-  External ring interface

Fig. 65

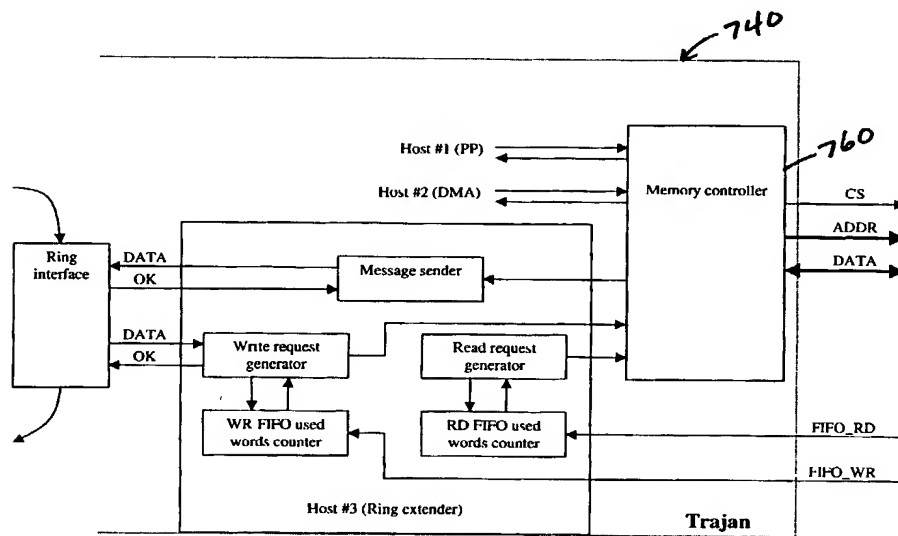
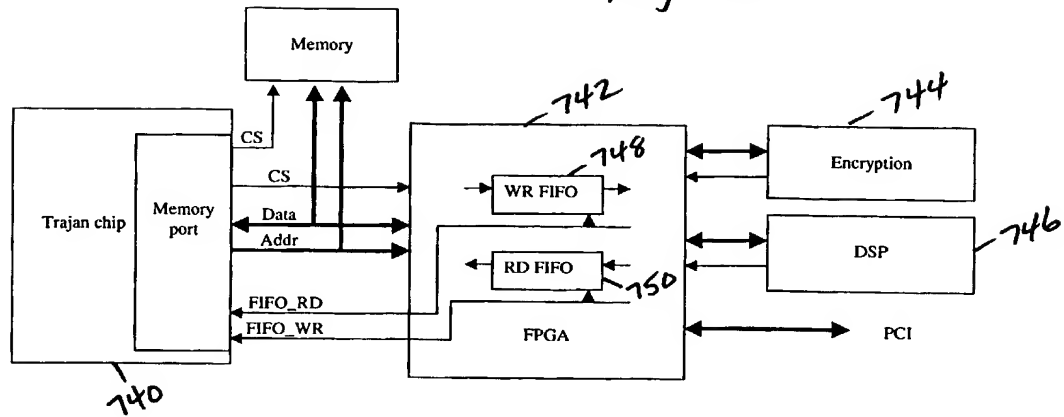


Fig. 66

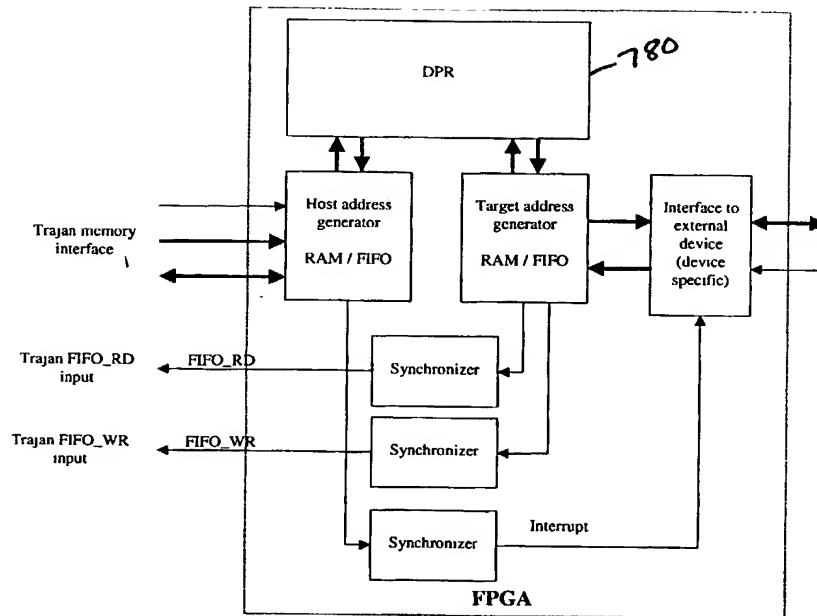


Fig. 67

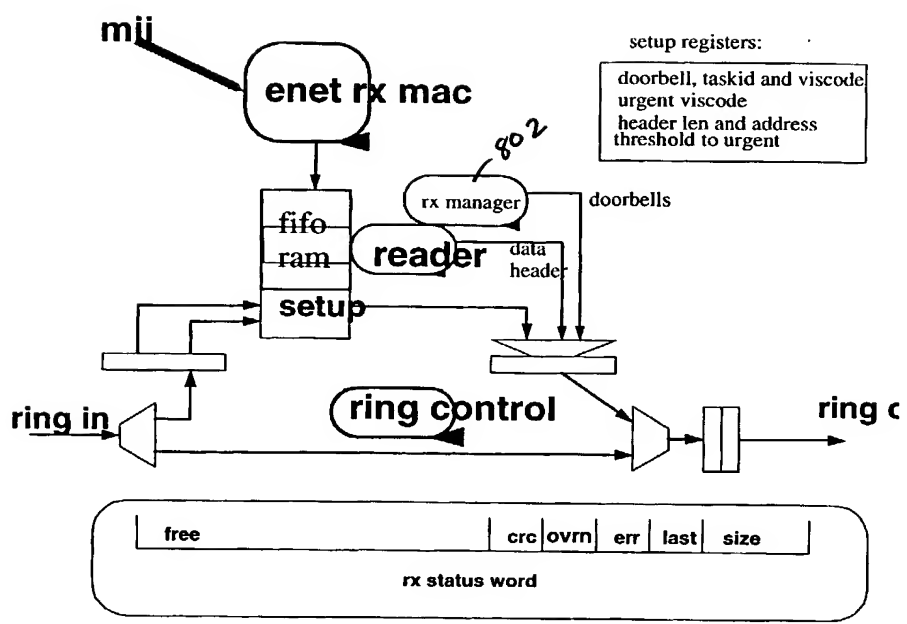


Fig. 68







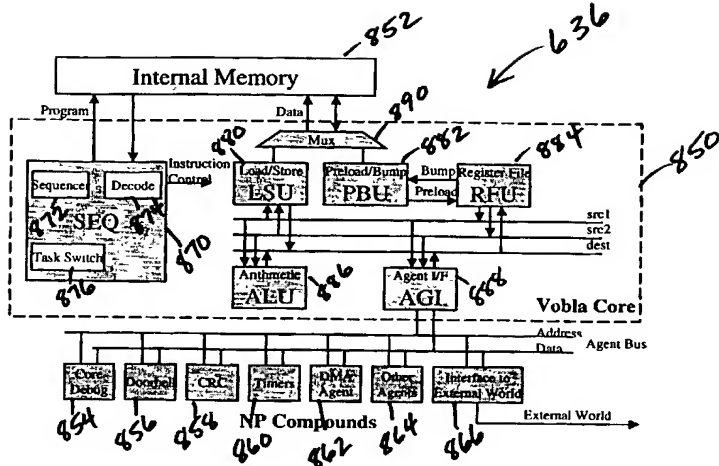


Fig. 72

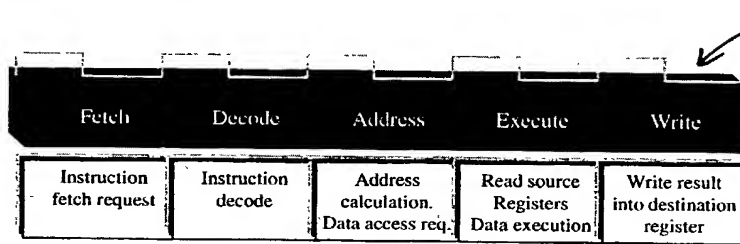
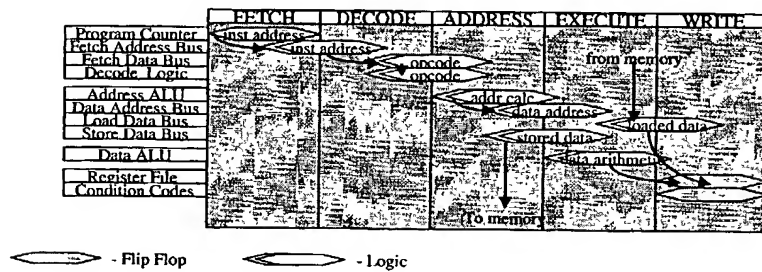
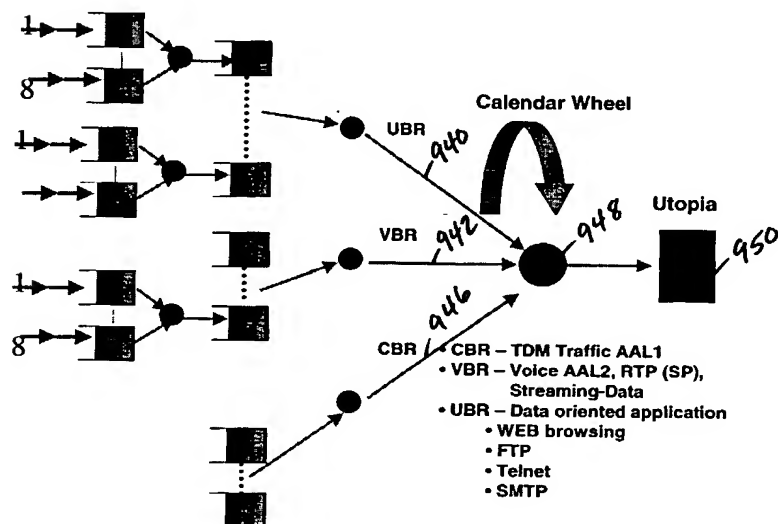
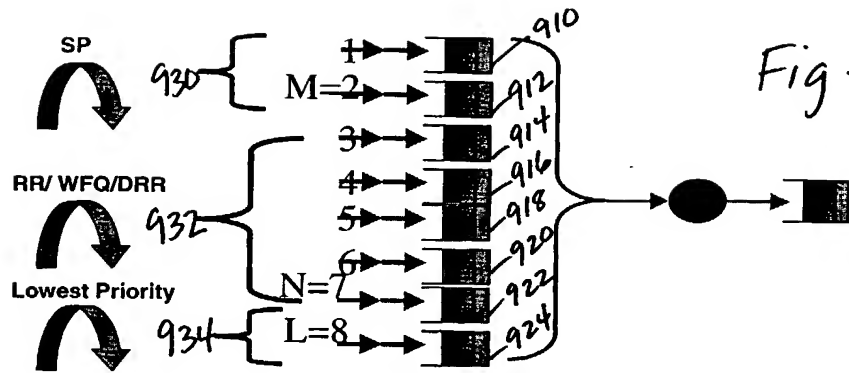


Fig. 73



◊ - Flip Flop    ◊ - Logic



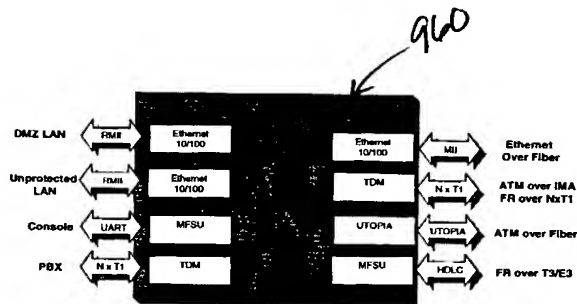


Fig.  
76

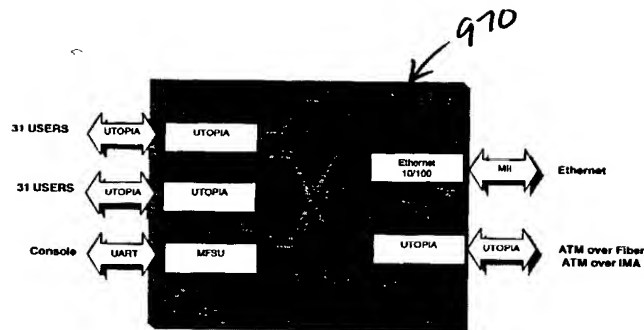


Fig.  
77

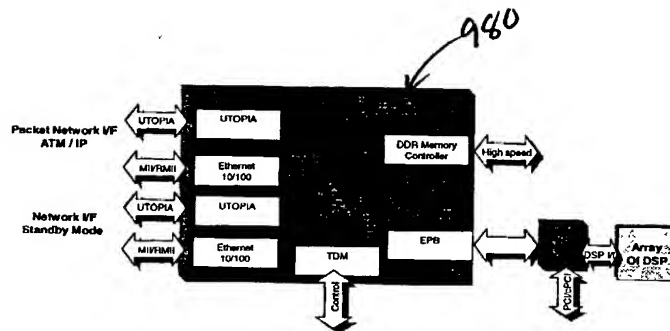


Fig. 78

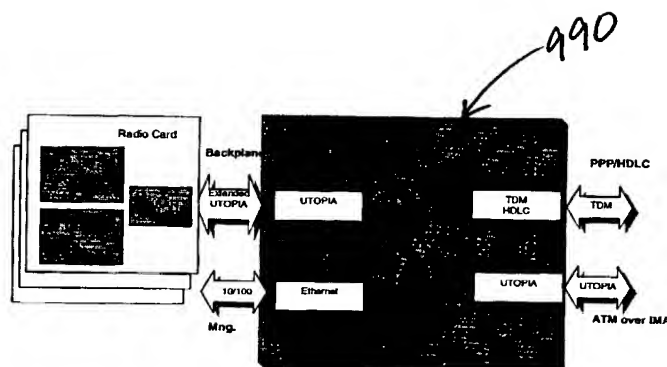


Fig. 79

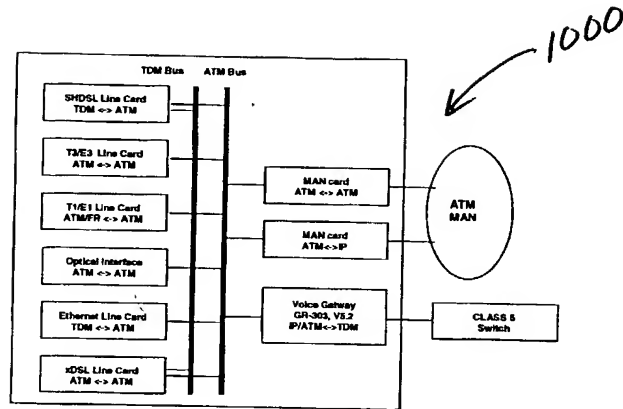


Fig. 80

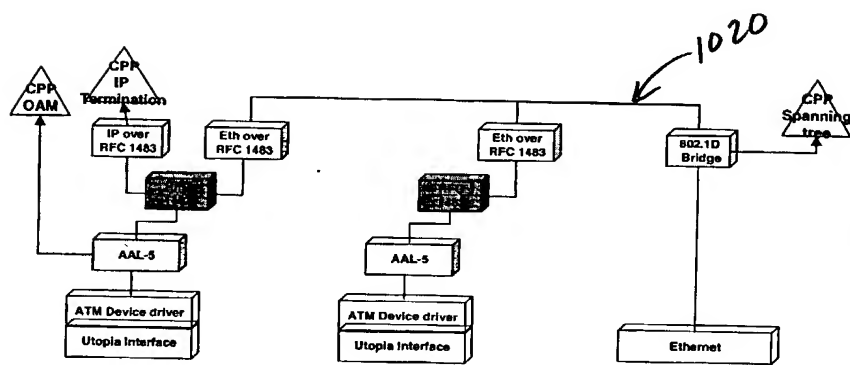


Fig. 81

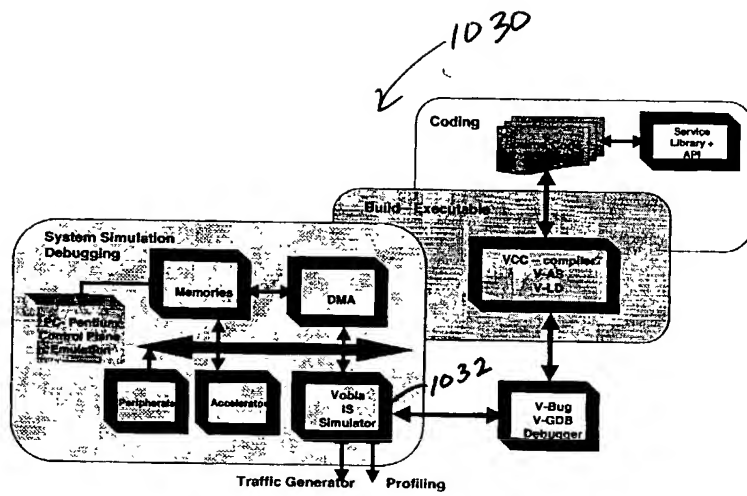


Fig. 82

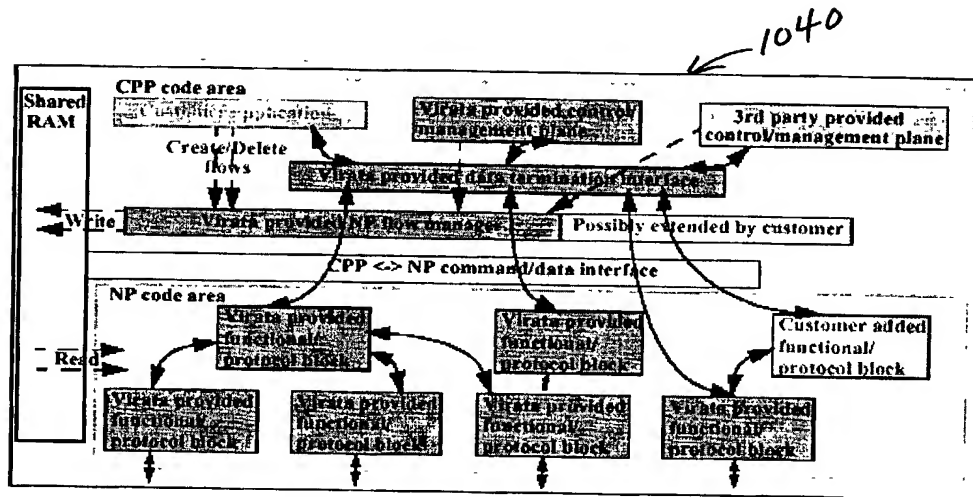
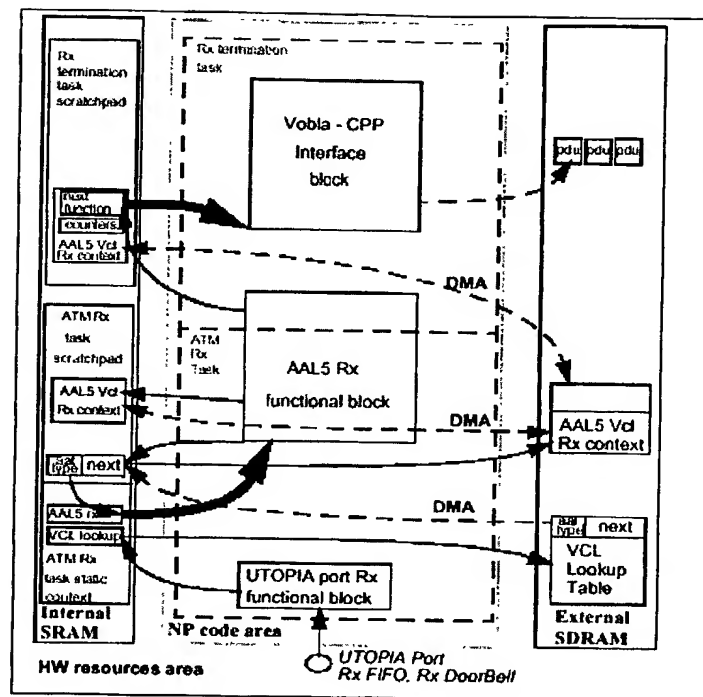
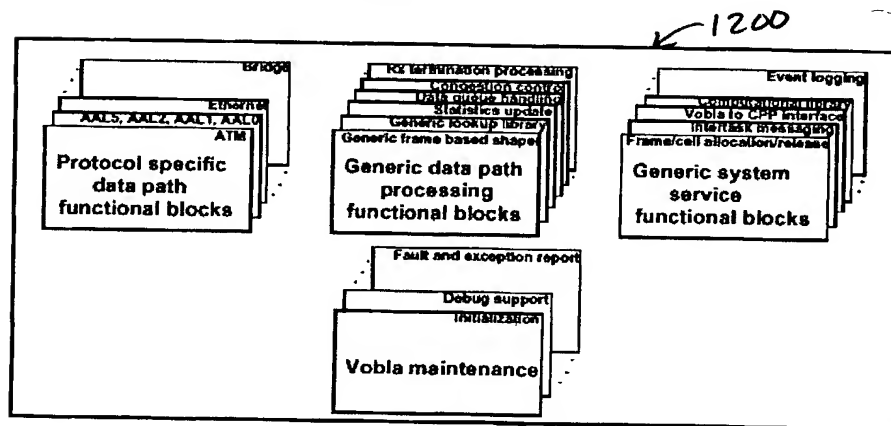
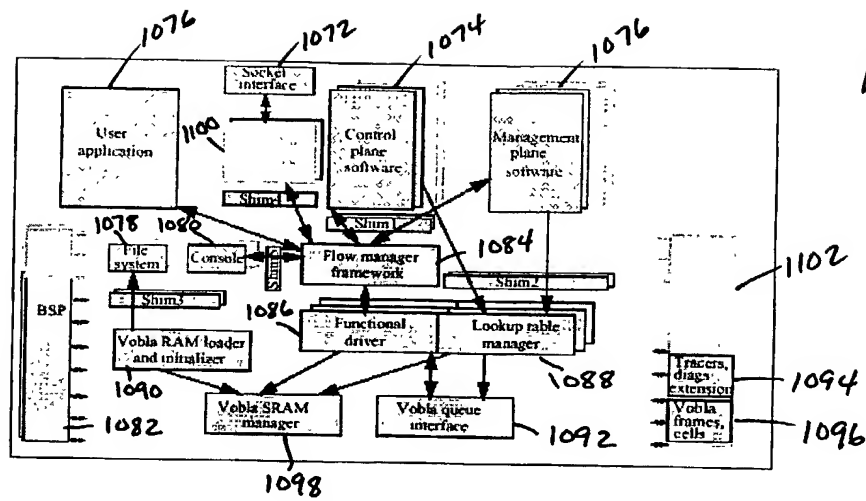


Fig. 83







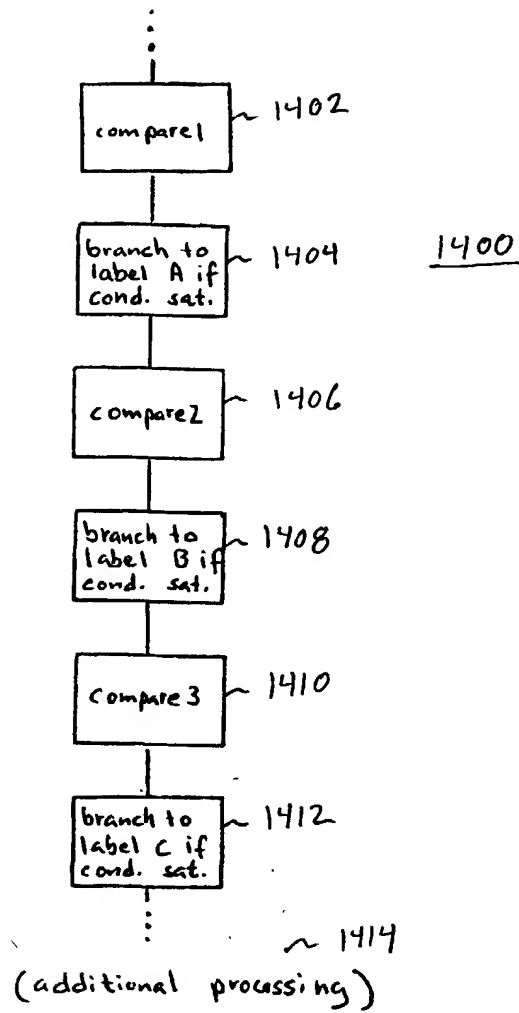


FIG. 87  
(PRIOR ART)

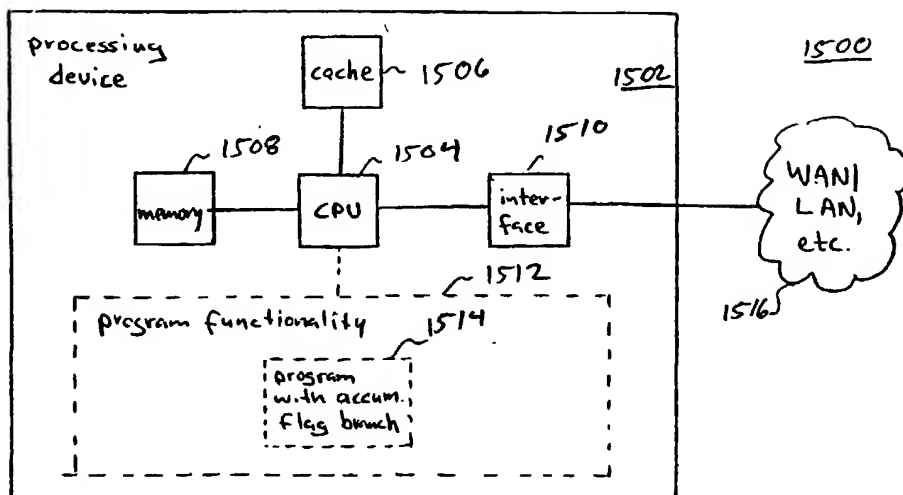


FIG. 88

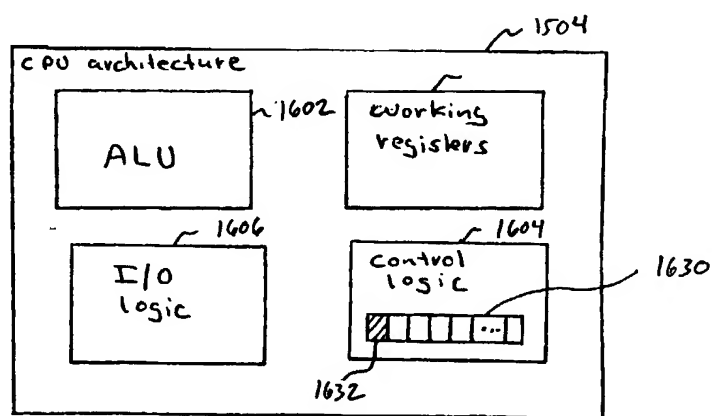


FIG. 89

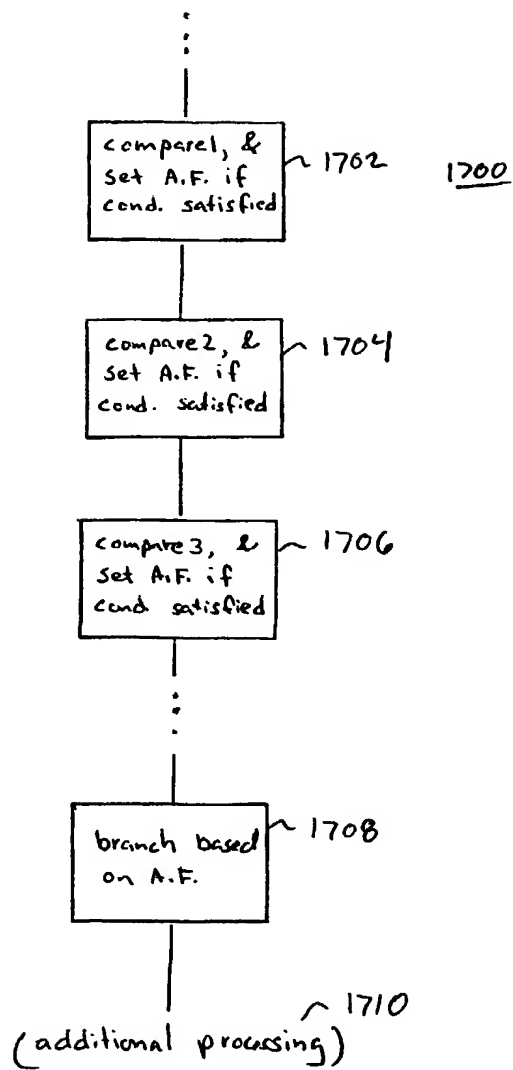


FIG. 90